

Gas Chromatographic Approaches to the Measurement of Adsorption Enthalpy of Fluids on Clay and Organoclay

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The adhesion of pollutants on soil is essentially an adsorptive separation process, one that must be understood in order to assess the magnitude of migration potential of contaminant spills. For example, on some soils, a contaminant may be effectively sequestered by clay in the soil, and thus never endanger or reach the groundwater. On other sites, the soil may have a much smaller interaction with the pollutant, and the groundwater or underlying aquifer may become contaminated. The enthalpy of adsorption, ΔH_{ads} , is the most important fundamental parameter that must be known to predict migration potential. We have recently developed two methods to measure the enthalpy of adsorption of fluids on clay and organoclay, both of which are based on gas chromatography. In both approaches, the chromatographic stationary phase is the platform for the soil substrate. The first is an extension of classical packed column chromatography, and the second is based on the development of a stable clay-coated open tubular (capillary) column. It is the second method that represents a major advance, and this technique will be described in detail. We will discuss the preparation of the clay and organoclay stationary phases, the stabilization of the stationary phases, and their general chromatographic behavior. The advantages and disadvantages of the packed and capillary column approaches will be compared. We will then discuss a series of measurements that were made using both the packed and capillary columns, for a clay and an organoclay stationary phase. The implications of the trends in the measurements will then be treated, both in terms of the soil-pollutant interaction mechanisms and environmental remediation consequences.